

P R O J E C T facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

CLEAN coal
TECHNOLOGY

CLEANING DENVER'S AIR BY NATURAL GAS REBURNING IN A COAL-FIRED POWER PLANT

PRIMARY PROJECT PARTNER

**Energy and Environmental
Research Corporation**
Irvine, CA

MAIN SITE

Cherokee Station
Unit 3
Public Service Company
of Colorado
Denver, CO

TOTAL ESTIMATED COST

\$17,819,000

COST SHARING

DOE	\$8,909,500
Non-DOE	\$8,909,500

Project Description

With the support of the U.S. Department of Energy, Energy and Environmental Research Corporation has demonstrated how natural gas can be used in combination with other pollution controls in a coal-fired power plant to improve air quality.

The technology is termed gas reburning. A small amount of natural gas (5% to 15% of the total fuel input) is injected above the main coal combustion zone. Emissions of smog-causing nitrogen oxides (NO_x) drifting upward from the coal combustion zone are converted to harmless molecular nitrogen in the fuel-rich gas reburning zone.

This innovative technology was combined with low-NO_x burners in a Clean Coal Technology project at Public Service Company of Colorado's Cherokee Station. Although low-NO_x burners are specifically designed to retard the formation of nitrogen oxides, gas reburning provides further reductions to meet stringent NO_x emissions limits. Following a successful demonstration at Cherokee, the utility elected to retain the equipment for continued use as an effective NO_x control device.

As an added benefit, sulfur dioxide (SO₂) pollutants also decrease in direct proportion to the amount of natural gas that is substituted for the feed coal.

NO_x emissions in Denver and surrounding regions in Colorado are a major concern because they contribute to ground-level ozone. Both power plants and automobiles are a major source of NO_x.

NO_x emissions from coal-fired power plants can be dramatically reduced using the innovations being demonstrated at the Cherokee Station. The highly reliable, low-maintenance pollution-control technologies provide a compact, low-cost means to control NO_x that can be applied to virtually all coal-fired boilers in the United States.

Program Goal

NO_x emissions from coal-fired utility power plants are a major environmental concern since they contribute significantly to the ground-level ozone. By demonstrating that gas reburning combined with low NO_x burners can reduce NO_x emissions up to 70%, the project at Cherokee Station promotes the Department's goal of improving environmental performance by using coal-fired power-generating systems. As a result of this project, technology is now available for commercial application.

Project Partners

PUBLIC SERVICE COMPANY OF COLORADO
Denver, CO
(host utility and cofunding)

COLORADO INTERSTATE GAS COMPANY
Colorado Springs, CO
(cofunding)

GAS RESEARCH INSTITUTE
Chicago, IL
(cofunding)

ELECTRIC POWER RESEARCH INSTITUTE
Palo Alto, CA
(cofunding)

CLEANING DENVER'S AIR BY NATURAL GAS REBURNING IN A COAL-FIRED POWER PLANT

CONTACT POINTS

Donald Engelhardt
Energy and Environmental
Research Corporation
Orrville, OH
(216) 682-4007
(216) 684-2110 fax

Jerry L. Hebb, P.E.
U.S. Department of Energy
Pittsburgh, PA
(412) 892-6079
(412) 892-4775 fax
hebb@petc.doe.gov

Project Benefits

Like many urban centers in the United States, Denver is looking for economical ways to reduce smog and visibility problems associated with air pollutants. NOx emissions have attracted increased attention in recent years as more is learned about their role in acid rain, smog, visibility impairments, and climate warming. While about half of all NOx pollutants come from automobiles and other vehicles, coal-burning boilers currently contribute about 25% of the total NOx emitted nationwide.

The Energy and Environmental Research Corporation's Clean Coal Technology project is showing how natural gas reburning and other innovative control techniques can be used to sharply reduce the NOx released from coal-burning plants.

Located in the greater metropolitan area of Denver, only a few miles from downtown, the demonstration project used low-NOx technologies retrofitted to an existing 172-megawatt boiler at Public Service Company of Colorado's Cherokee Station. Testing of the technologies shows that:

- Up to 70% of the NOx previously emitted from the boiler can be either prevented from forming or converted to harmless molecular nitrogen.
- No chemicals are required and no additional solid or liquid wastes are produced by these environmental control technologies.
- SO₂ emissions and particulates can be reduced by substituting natural gas for 5% to 15% of the energy value of coal.
- The technology is reliable and requires low maintenance.

The gas-reburning/low-NOx burner combination is likely to become one of the most cost-effective pollution-control technologies for meeting NOx reduction standards set by the 1990 Clean Air Act Amendments. The technology can be retrofitted to virtually any existing utility or industrial boiler and will be attractive as a low-cost environmental technology for new power plants in both eastern and western United States.

Cost Profile (Dollars in Millions)

	Prior Investment	FY95	FY96	FY97	Future Funds
Department of Energy *	\$8.1	\$0.6	\$0.2	—	—
Private Sector Partners	\$8.1	\$0.6	\$0.2	—	—

* Appropriated Funding

Key Milestones

FY90	FY91	FY92	FY93	FY94	FY95	FY96
	Design	Construction	Demonstration and Testing			
Contract awarded 10/13/90		Phase II startup 6/13/91	Phase III startup 9/92		Testing completed 1/26/95	Final report 6/30/96
		Startup completed 6/30/92	Testing completed 1/94	Modification completed 3/6/94		Final site work completed 11/21/95